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Editorial Musings

Comparison of computed tomographic urography, magnetic resonance urography and the combination of diffusion weighted imaging in diagnosis of upper urinary tract cancer

Guang-yu Wu[a], Qing Lu[a], Lian-ming Wu[a], Jin Zhang[b], Xiao-xi Chen[a], Jian-rong Xu[a,*]

[a] Department of Radiology, Renji Hospital, Shanghai Jiao Tong University School of Medicine, No. 1630, Dongfang Road, Pudong, Shanghai 200120, PR China
[b] Department of Urinary Surgery, Renji Hospital, Shanghai Jiao Tong University School of Medicine, No. 1630, Dongfang Road, Pudong, Shanghai 200120, PR China

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ABSTRACT

Purpose: To evaluate the performance of computed tomographic urography (CTU), static-fluid magnetic resonance urography (static-fluid MRU) and combinations of CTU, static-fluid MRU and diffusion weighted imaging (DWI) in the diagnosis of upper urinary tract cancer.
Material and Methods: Between January 2010 and June 2011, patients with suspected UUT cancer underwent CTU, static-fluid MRU and DWI ($b = 1000\,s/mm^2$) within a 1-week period. The diagnostic performances of CTU, static-fluid MRU and combinations of CTU, static-fluid MRU and DWI for upper urinary tract cancer were prospectively evaluated. The ureteroscopic and histopathologic findings were compared with the imaging findings.
Results: Compared to static-fluid MRU alone (sensitivity: 76/75%, reader 1/reader 2), combining DWI with MRI can increase the sensitivity (sensitivity: 84/84%, $p = 0.031/p = 0.016$) of upper urinary tract cancer diagnosis. CTU had greater sensitivity (95/94%) and accuracy (92/91%) than both static-fluid MRU (sensitivity: $p < 0.001/p < 0.001$ and accuracy: 83/81%, $p = 0.001/p < 0.001$) and static-fluid MRU with DWI (sensitivity: $p = 0.023/p = 0.039$ and accuracy: 87/85%, $p = 0.042/p = 0.049$) for the diagnosis of upper urinary tract cancers. Compared with CTU alone, CTU with DWI did not significantly increase sensitivity, specificity or accuracy. However, the diagnostic confidence was improved when the combined technique was used ($p = 0.031/p = 0.024$). Moreover, there was no significant change in sensitivity, specificity, accuracy or diagnostic confidence when static-fluid MRU was used in combination with CTU and DWI.
Conclusion: Although there is a potential role for static-fluid MRU and static-fluid MRU with DWI in urinary tract imaging, CTU is still the better choice for the diagnosis of upper urinary tract cancer. Combining DWI with CTU can help improve confidence in upper urinary tract cancer diagnoses.

1. Introduction

The clinical presentation of upper urinary tract (UUT) diseases, including UUT cancer, is non-specific. Therefore, the majority of urinary tract lesions require evaluation by imaging modalities [1]. Computed tomographic urography (CTU) is the most frequently used imaging modality for the evaluation of UUT disease [2]. However, CTU is associated with radiation doses that depend on the number of phases, the indication and the technical parameters used [3,4]. Magnetic resonance urography (MRU), including static-fluid MR urography (static-fluid MRU) and contrast enhanced MR urography (CE-MRU), is an alternative imaging technique for the evaluation of the UUT [5]. Nevertheless, it performs worse than CTU in diagnosing urothelial malignancy [6].

A recent study reported that DWI noninvasively provides accurate information for the diagnosis of upper urinary tract cancer [7]. To the best of our knowledge, there are still no studies that compare the diagnostic performance and the confidence level of different combinations of CTU, static-fluid MRU and DWI for the diagnosis of UUT cancer. Furthermore, the previous study [7] demonstrated that CE-MRU did not improve diagnosis when combined with

* Corresponding author. Tel.: +86 21 68383259; fax: +86 21 67052375.
E-mail address: renjixujr@163.com (J.-r. Xu).

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Table 1
MRU and DWI imaging sequences and parameters.

Parameter	Value			
	T1W	T2W	MRU	DWI
Type of pulse sequence	Fast spoiled gradient echo	Fast spin echo	Fast spin echo	Single-shot spin echo planar imaging
Respiration	Holding breath	Navigator controlled	Navigator controlled	Navigator controlled
TR/TE (ms)	170/2.3	3300/90	7000/650	1500/68
Partition thickness (mm)	4	4	2	4
Inter-slice gap (mm)	0.5	0.5	0.5	0.5
Matrix	256 × 256	256 × 256	512 × 512	256 × 256
Fat suppression	N	Spectral attenuated inversion recovery	Spectral attenuated inversion recovery	N
Number of excitations	4	1	4	4

static-fluid MRU and DWI. Therefore, we evaluated the performance and diagnostic confidence of computed tomographic urography and magnetic resonance urography alone or in combination with diffusion weighted imaging for the diagnosis of UUT cancer.

2. Material and methods

The protocols used in our study, including ureteroscopy, were approved by the Institutional Review Board. Informed consent was obtained from all patients. Between January 2009 and June 2011, 186 consecutive patients have or suspected (symptomless persistent gross haematuria) upper urinary tract cancer were enrolled. A total of 19 patients were excluded, as or follow-up examination failed to result in a final diagnosis. 3 patients were excluded because of an allergy to iodine, and 1 patient was excluded because of a metal prosthesis. The remaining 163 patients (127 men and 34 women; age range, 38–82 years; mean age, 62.1 years) formed the study population and were examined by CTU, static-fluid MRU (including axial T1W and T2W imaging) and DWI ($b = 1000\ s/mm^2$) before any surgical intervention was performed. The interval between CTU and static-fluid MRU with DWI for each patient was less than 1 week.

The diagnosis of upper urinary tract cancer was confirmed by surgery or ureteroscopic biopsy within 1 week of CTU and MR imaging. A diagnosis of benign UUT disease was established by ureteroscopic biopsy, and negative diagnoses were confirmed by ureteroscopy. Both diagnoses were confirmed with clinical and imaging data after an 18-month follow-up.

2.1. Imaging protocols

CTU studies were performed using a 64-MDCT scanner (VCT LightSpeed, GE Healthcare) with a three-phase protocol. All patients were administered 400–500 mL of water orally 20 min before the examination. Unenhanced CT scans of the abdomen and pelvis were obtained. Nephrographic phase images were then obtained from the diaphragm through the kidneys beginning 100 s after a 30-second injection of non-ionic contrast medium (Iopamiro, Bracco, Milan, Italy) at a dose of 2 mL/kg. Excretory phase images of the abdomen and pelvis were obtained 8 min after the injection of contrast material. The scanning parameters

Table 2
Performance in the diagnosis of upper urinary tract cancer using single techniques.

Exam protocol	Result							
	TP	TN	FP	FN	Sensitivity	Specificity	Accuracy	Az
CTU								
Reader 1	75	75	9	4	0.95 (75/79)	0.89 (75/84)	0.92 (150/163)	0.919
Reader 2	74	74	10	5	0.94 (74/79)	0.88 (74/84)	0.91 (148/163)	0.912
P value								
Reader 1								
Vs. MRU					$p < 0.001$	N	$p = 0.001$	$p < 0.001$
Vs. MRU + DWI	Not applicable				$p = 0.023$	N	$p = 0.042$	N
Reader 2								
Vs. MRU					$p < 0.001$	N	$p < 0.001$	$p < 0.001$
Vs. MRU + DWI					$p = 0.039$	N	$p = 0.049$	N
MRU								
Reader 1	60	76	8	19	0.76 (60/79)	0.91 (76/84)	0.83 (136/161)	0.828
Reader 2	59	73	11	20	0.75 (59/79)	0.87 (73/84)	0.81 (132/161)	0.817
P value								
Reader 1								
Vs. MRU + DWI	Not applicable				$p = 0.031$	N	N	$p = 0.002$
Reader 2								
Vs. MRU + DWI					$p = 0.016$	N	N	$p = 0.003$
MRU + DWI								
Reader 1	66	75	9	13	0.84 (66/79)	0.89 (75/84)	0.87 (141/161)	0.892
Reader 2	66	73	11	13	0.84 (66/79)	0.87 (73/84)	0.85 (139/161)	0.887

Az = area under the receiver operating characteristic curve, FN = false negative, FP = false positive, TN = true negative, TP = true positive, and N = no significant difference.